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SUMMARY

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THE PRODUCTION OF SULPHURIC ACID FROM ALTERNATIVE SOURCES OF SULPHUR

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AUTHORS' SUMMARY

THE PRODUCTION OF SULPHURIC ACID FROM ALTERNATIVE SOURCES OF SULPHUR

by J.D. McFarlane and V. Robinson

a) Sources of Sulphur

In most places in the world the cheapest sulphuric acid is made from the burning of raw sulphur. This is obtained mainly from the United States and Mexico or from sulphur recovered in gas purification at Lacq in France. This means that developing countries must use alternative indigenous sources of sulphur bearing material or must import sulphur.

The major alternative to sulphur is iron pyrites and this is widely distributed so that it is available in some of the developing countries. The cost of acid produced from it depends to a great degree upon the distance the pyrites must be transported: it also depends on the value of the residual iron oxide cinder, the latter is affected by the arsenic content and the amount of copper which can be leeched out and by the proximity of an iron and steel works.

Many developing countries are favoured with ore deposits containing sulphides of non-ferrous metals. These ores require roasting before the metal can be smelted and during the roasting operations large quantities of gas containing SO_2 are produced. In the past all this was wasted to the detriment of the surrounding countryside, today it is normal for these gases to be treated and for them to be converted into sulphuric acid which has become an essential and valuable by product.

Other alternative sources of sulphur which are at present used for making sulphuric acid include calcium sulphate and anhydrite. The process here involves a combination of cement and sulphuric acid production. In addition hydrogen sulphide arises in many purification processes as a by product and this can be turned into sulphuric acid or some times into sulphur. Further alternative sources are the roasting of "spent oxide" from the purification of carbonisation gases, also the roasting of ferrous sulphate from the titanium dioxide and iron and steel pickling industries.

b) Production of sulphuric acid from elemental sulphur is essentially simple. The sulphur is burnt in the presence of atmospheric oxygen to give SO_2 which is then combined with further oxygen over a catalyst to give SO_3 gas. The catalysts today are based mainly on vanadium pentoxide and process kinetics require a temperature of about 400°C to be maintained through the several beds of catalysts by extraction of heat between stages. The recovery of the heat of combustion of the sulphur and conversion of the SO_2 to SO_3 can produce steam which may be sufficiently valuable to enable the acid to be produced for little more than the cost of the sulphur.

The production of acid from other raw materials is appreciably more complicated, firstly in producing the SO_2 gas and secondly in treating it to make it clean enough for conversion to SO_3.

From pyrites a gas containing SO_2 can be achieved by roasting by one of several processes, the choice depending upon the type of pyrites, the gas strength produced, the quality of cinder required and the capacity of the plant. Similar roasters can be used for burning spent oxide whereas the use of calcium sulphate requires the cement type rotary kiln fed with suitable raw materials plus fuel so that the resulting gas is the right strength and the cement clinker of the required quality.

The gas containing SO_2 from the roasting of non-ferrous ores or from any of the processes just mentioned, normally contain water vapour and dust in suspension. The dust must therefore be removed by cyclones and electrostatic dust precipitators often followed by washing and cooling for further cleaning. Finally the cooled gas relatively dust free normally goes to wet electrostatic precipitators so that cooled dried gas is suitable for catalytic conversion (after reheating).

Occasionally a gas containing H_2S free from all suspended solids is available at suitable strength. This can be burned in a "wet" catalysis plant, though at present such plants can produce only comparatively weak acid. All the other plants mentioned can give 98% acid with ease or can be adapted to produce oleum.

In the paper flow diagrams are given.

c) Sulphuric acid can be produced from sulphur in single stream units from below 10 tons per day of acid to well over 1,000 tons per day. For other processes the minimum size for one stream may be larger and it may be necessary to go to multiple stream design for some parts of the plant at capacities of much less than 1,000 tons per day. day
In the developing countries the economics of small plants are frequently attractive for various special reasons. Elsewhere cost comparisons, given in the paper, show the advantages of large scale operation. For a country where pyrites does not need to be transported too far, and where there is a sale for the cinder, acid production costs for all plant capacities are similar to those from elemental sulphur. However the cost per ton of acid produced at 500 tons per day in one unit may be at least 10% less than the cost at 100 tons per day.

The cost of production from by product gases from say roasting non-ferrous sulphide ores depends entirely upon what cost if any is charged for these gases.

d) There is no doubt that there is available to the developing countries the necessary technical knowledge in gas production and treatment and catalyst conversion to allow the use of any indigenous sulphur bearing raw materials of suitable quality.

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